On Fine Structure and Control of Vertical Aerosol Exchange between 700 m and 3000 m

New Methods and Results

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With 28 Figures

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Summary

Described are technical details of telemetry systems which permit, by means of cable cars, to record in a routine manner, up to 3000 m a.s.l., the profiles of temperature, humidity, wind, air conductivity, and potential gradient, against pressure as a parameter of altitude.

From the profiles of air conductivity the vertical mass exchange coefficient is calculated as a function of altitude (in small incremental intervals). The following factors enter into the computation: the ion production rate as a function of altitude, the concentration of Aitken nuclei, and the coagulation rate in the Aitken nuclei particle size range, as recorded at our stations.

Examples demonstrate the effectiveness of the method: control of the vertical aerosol exchange through several single and multiple temperature layers situated at various altitudes, their fine structure being related to the fine structure of

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the altitude dependence of the exchange coefficient; structure of the upper boundary of the exchange layer in relation to aerosol transport and aerological structure; action of wind shear upon aerosol transport. The measured data are statistically evaluated from various aspects.

### Zusammenfassung

#### Feinstruktur und Steuerung des vertikalen Aerosolaustausches zwischen 700 und 3000 m. Neue Methoden und Resultate

Es werden technische Einzelheiten von Telemetriesystemen beschrieben, welche gestatten, mittels Gondeln an Berghabnern bis 3000 m routinemäßig Profile von Temperatur, Feuchte, Wind, Luftleitfähigkeit und Potentialgradient in Abhängigkeit vom Luftdruck als Höhenparameter zu registrieren.

Aus den Profilen der Luftleitfähigkeit wird der vertikale Austauschkoefizient als Funktion der Höhe (in kleinen Höhenintervallen) berechnet, wobei die Ionisationsstärke als Funktion der Höhe, die registrierten Konzentrationen von Aitkenkernen und die Koagulationsrate berücksichtigt werden.

Anhand von Beispielen wird die Leistungsfähigkeit der Methode dargelegt: Steuerung des vertikalen Aerosolaustausches durch in verschiedenen Höhen gene gene einfache und mehrfache Inversionen, wobei deren Feinstruktur mit der Feinstruktur der Höhenabhängigkeit des Austauschkoefizienten in Beziehung gebracht wird; Struktur der Austauschobergrenze in bezug zum Aerosoltransport. Die Meßdaten werden nach verschiedenen Gesichtspunkten statistisch ausgewertet.

### 1. Introduction

The importance that is being attached to a practicable solution of the question concerning the control mechanisms of the vertical exchange of atmospheric aerosols is still growing. The continued increase of air pollution in the biosphere is contributing thereto. In an earlier publication [1] we already included an extract from the most important literature of the last 10 or 20 years, dealing with atmospheric exchange research. Said compilation could now be augmented by adding further contributions which we shall, however, refrain from doing here. There are practically no more recent experimental studies concerning the vertical exchange within a stratum of the boundary layer of at least 1 to 3 km, based on an actually given and continuously measured distribution of aerosols in the atmosphere. This has encouraged us to continue and extend methodically our previous investigations [1—12].

We consider it our specific task to gradually develop all those parameters controlling, in detail, the vertical distribution of aerosols in the lowermost kilometers of the troposphere. Our final objective is later on to develop, from these experiences, rules and procedures for the practical man to apply, permitting him to estimate with satisfactory exactness, from customary aerological data obtained in